



Large Dams and Changes in an Agrarian Society: Gendering the Impacts of Damodar Valley Corporation in Eastern India

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ABSTRACT: This paper traces the gendered changes in agrarian livelihoods in the lower Damodar valley of eastern India and connects these changes to the large dam project of the Damodar Valley Corporation (DVC). The DVC, established in 1948, was one of the earliest dam projects in India. Although it was not fully completed, the DVC project has initiated unforeseen changes in the farming economy. The floods for which the Damodar river was notorious were not fully controlled, and the suffering of people living in the lower reaches of the valley never really diminished. This paper gives a brief description of the river and its history of water management practices and the roles of women and men in these practices. It traces the resultant impacts on gender roles, and outlines the new kinds of water management that emerged in response to the DVC's failure to provide irrigation water when demanded. More specifically, the paper explores the changes in floods, changes in the farming economy, and the impacts of temporary sand dams or *boro bandhs* on the livelihoods of women and men from farming families in the Lower Damodar Valley. It observes that even over a longer temporal scale, the changes unleashed by large water control projects have significant and gendered impacts on agrarian societies.

KEYWORDS: Gender impacts, canal irrigation, Damodar Valley Corporation, floods, large dams, West Bengal, India

IMPACTS OF LARGE DAMS ON WOMEN AND MEN

A growing body of literature has recently explored the impacts of large and centralised water control projects on the livelihoods of poor people, especially the more vulnerable communities that are susceptible to livelihood shocks from deteriorating environmental resource bases. Evidence is accumulating that women and men are not affected in the same way by large-scale resource development projects (see Ahmad and Lahiri-Dutt, 2006; Mehta, 2009) or large-scale land deals (Behrman, et al., 2011). Lahiri-Dutt and Ahmad (2012) argue that differences in gender roles account for the differential impacts on women and men. Evidence also suggests that women and men commonly adopt multiple livelihood strategies according to geographical scales and climatic season (Cleaver, 1998; Valdivia and Gilles, 2001). Yet many water engineers, administrators, and policy-makers continue to see 'the community' or 'the family' as a homogeneous unit, and neglect the intricate complexities of gender roles, tasks, and power relations residing within these units. Critiquing such purely technocentric views, Jones (2006) observed:

[I]arge dams are more than just concrete and water. They have huge environmental and social impacts, and are often political strategies in disguise... Analysis of dam projects still often describes affected peoples as genderless, focusing on homogeneous 'households' and disregarding communities and family units as sites of gendered interaction. The reality is, however, that women's relationship with water is different to that of men's, which should be taken into account in all planning phases of dam development.

Drawing on this comment, I explore a grey area in the existing literature: the gender differentiated impacts of older large dam projects. 'Older' or established projects have been in existence for some

time, allowing for adequate manifestation of resultant agrarian and societal changes in a number of areas of the regional economy. Existing literature points to the negative impacts of new or large water projects under construction on women – physical displacement and consequent loss of culture – but the longer-term impacts of centralised large-scale water management projects can be a lot more complex. For example, new water supply regimes set off a radical process of agrarian change that includes altered processes and technologies of production, different crops, transformed human-water-land interactions, and different expectations. Land and water systems are at the heart of many social norms, including gender relations, in farming communities. Interventions on land and water change production relations and exacerbate power inequalities between women and men; thus they 'engineer' not only a physical infrastructure, but also a masculine social order. Often the full extent or the depth of the interdependence of the two is not immediately apparent and being connected with a multitude of related factors, the full consequences for gender relations may take years or even decades to be manifested.

One can start by looking at history for an example. Talwar-Oldenburg (2010) has shown how changes in the land revenue system in rural Punjab during the colonial period, that purported to modernise the world of peasants, severely enhanced the masculinity of the farming communities who had used land and water resources for generations. As land became owned by men, such ownership of land became equated with social prestige, and the multitude of tasks that rural women performed on the land lost their importance to society (Talwar-Oldenburg, 2010). This created a fierce desire in parents for sons and reduced the value of girls in Punjab. Today's rural Punjab, whilst known for its agro-based prosperity, continues to bear this patriarchal burden in its low sex ratio, daughter abhorrence and disposability of women.

Clearly, the investigation of gendered impacts of long-in-existence large dam projects demands a new and interdisciplinary epistemology, as suggested by Whitehead (2002). In this paper, an environmental and historical understanding of the regional context, and the role of the Damodar river in sustaining rural life before and after the engineering intervention, provide the canvas on which to trace changes in social relations and scrutinise them through a gender lens. Doing so involves examining the changes that have occurred in gender roles and status as a result of altered water management regimes and the transformation of the farming economy under the sheer weight of the project. To explore how changing gender relations have altered power relations, I also examine who bears the brunt of negative changes at present and who gains from them.

WHY GENDER?

I argue that the differences in impacts of developmental projects arise primarily from a sexually-based division of labour, along with local and cultural discourses on gender roles. These discourses produce and reinforce specific constructions of gender ideals and create norms for women and men. The roles and tasks may be formally accepted as laws or informally understood as cultural ideals, but they are invariably connected to power relations and women and men's social and economic positioning within societies and families. This argument is different from either the ecofeminist position (of equating women with nature) or the anthropological position that illuminates the aesthetic relationships between women and water (see Naguib, Forthcoming). Consequently, it becomes an important task to understand why changes do not always affect women and men in similar ways. Women in poor communities generally constitute the poorest or weakest group, bearing the burden of care for children and family, while performing productive tasks that are often less visible or less recognised. Indeed, in her studies of rural economies of Africa undergoing transition initiated by economic policies, Whitehead (2009) has shown that different gender roles lead to different impacts on women and men. In poor farming households of rural Bengal, an important aspect of women's lives is the disproportionately high work burdens at home as well as on farms. This burden is heavier for women in landless families, who commonly belong to scheduled or lower castes. In rural Bengal, the public and

private spheres continue to be seen as largely separate. Consequent to the dominant perception that women belong to the reproductive domain, the relentless work performed by most women on farms remains invisible to experts.

Large dams or statist water management mechanisms – synonymous with development and progress – are expected to reduce the vulnerabilities of poor farming families from floods and water scarcities. The utilitarian and Benthamian logic of 'the greatest happiness for the greatest number' allows total control over land and water resources by the state, which then becomes the eminent domain, enshrining the welfare principle of 'greater common good' (Rayner, 2003). Like other infrastructural projects, large dams have immense social consequences. It is possible that in a society differentiated on the basis of class, caste, ethnicity and religion, some people will benefit more than others from these projects. It has been demonstrated that powerless, voiceless, weak, and poorer people are subject to the worst impacts, especially with respect to involuntary displacement (Cernea and Guggenheim, 1993; World Commission on Dams, 2002). Mehta and Srinivasan (1999) note that in such projects development is often equated with economic growth, and that this assures livelihoods and promises to reduce poverty, but in reality the benefits produced, such as improved livelihoods, economic resources, and power are not evenly distributed. Furthermore, as Cernea (2000) notes: "the principle of the 'greater good for the larger numbers' routinely invoked to rationalise forced displacement is, in fact, often abused.... Some people enjoy the gains of development, while others bear its pain". For example, studies of large dam impacts by Parasuram (1993) and Ganguly-Thukral (1996) have clearly shown that women and children are more vulnerable to the negative impacts of large water management projects. That ethnic or indigenous minorities are negatively affected by many large water projects is now more or less recognised, but Mehta and Srinivasan (1999) lamented that little literature is available on how the impacts are gendered. In their work on gender and displacement by large dam projects, Mehta and Srinivasan (1999) argued that

large dams have far-reaching consequences on the economic, social and cultural contexts within which men and women live their lives. Largely, the spread of pains and gains has not been equal. To some extent, this is because of gender biases, ignorance and reductionist modes of operating in dam-building activities.

More recently, Mehta (forthcoming) observes that large dams alter women's access to and control over water resources, and destroy the autonomy that women enjoy in collecting water. Instead, they are dependent on the government, host villagers and other people for their daily supply. She suggests that in resettlement villages around the Sardar Sarovar project on the Narmada river, women express the sentiment that they prefer the 'drudgery' of their submergence village to counter 'official' views of drudgery.

The impact of a large dam project on livelihoods, through new modes of irrigation, may take decades to become apparent. Examples of livelihood impacts of changed water management and resultant gendered and, often unplanned, outcomes can be drawn, however, from the works of Zwarteveen and Neupane (1995), Meinzen-Dick et al. (1997), Meinzen-Dick and Zwarteveen (1998), and von Benda-Beckmann and von Benda-Beckmann (1998). Zwarteveen's (1994) work emphasises that farm households are not just recipients of irrigation, but are 'transformers' of this water into agricultural products by skilfully coordinating their labour, knowledge and other resources, and since these labour processes, knowledges and assets are gender-differentiated, their needs and interests would also be gender-specific.

This paper follows this literature to show the multifaceted changes in gender and livelihood in a small part of rural Bengal, the lower Damodar valley, comprising the three districts of Burdwan, Hooghly, and Howrah in West Bengal, India.¹ Except the western part of Burdwan district, the many old

¹ These are old spellings of these place-names. The names of these districts are now officially spelt as Bardhaman, Hugli, and Haora. Also, the western part of Burdwan district is more accurately a transitional zone between lower and upper parts of the Damodar valley.

and now cut-off tributaries of the Damodar river had at one time formed an unusual inland delta before merging with the Bhagirathi-Hooghly river east of the Burdwan town. The bowl-like inland delta region now supports one of the densest populations in the world. This also was one of the earliest parts of India to experience increases in agricultural production since the late 1960s. The agrarian transition of the region has been intensively studied by economists to explore the 'institutional versus technological' or 'state-action versus private incentive' dichotomies (see Harriss, 1993; Sengupta and Gazdar, 1997; Bose, 1999). The post-land reforms rural growth of the 1980s in the area was spectacular, intensive and noticeable enough to attract such scholarly attention. Yet gender inequalities in farming families have received comparatively less attention. Exacerbated by the new mode of water management, such inequalities have strengthened against a context of lack of recognition of rights, lower education and formal work participation, and many social prejudices that bear evidence of the unequal status of women and men.

Formal water control mechanisms, such as embankments and canals, have been long established in the lower Damodar region to provide flood and irrigation water security. However, the introduction of the large-scale multi-purpose river valley project, Damodar Valley Corporation (DVC) into this system had far-reaching impacts on the agrarian economy. In response, gender relations in farming families also changed significantly. The changed river regime has remarkably altered livelihoods and has created the expectation of greater security from floods but has increased vulnerabilities from unpredictable inundations. The introduction of capital-intensive rice-farming for cash has also increased demands for irrigation water in winter. As the DVC heralded the intensification of irrigated agriculture and raised the farmers' expectations of water security, changes in the river's ecology and natural water regimes made floods more difficult to cope with than before.

Not all of these impacts are perceived and experienced in the same way by women and men. Some of these perceptions, as well as the coping strategies of women and men that I have outlined in the following section, draw attention to the complexity of gendered livelihoods and concerns.

This paper is based on my long-term research on the DVC and the lower Damodar valley,² as well as on close engagement since the late 1990s with three local community groups working on environmental issues in the region. Over the years, I have undertaken several projects in the region, including livelihood surveys of women and men; perception surveys of flood vulnerabilities; and a study of locally based water management practices. Material from these surveys is used in the paper, which uses some narratives from interviews to illustrate the livelihoods, vulnerabilities, and perceptual differences between women and men. The names of the respondents have been changed to protect their identities.

FLOODS OF THE DAMODAR RIVER AND CONTROL MEASURES

The seasonal flows of Damodar river, flowing through the eastern Indian states of Bihar and West Bengal to eventually meet the Hooghly river near Falta point in Howrah district, are notorious. The upper and lower reaches of the Damodar – with a transitional part in the middle – have contrasting ecological characteristics causing the lower one-third of its 23,931 km² basin to be characteristically flood-prone. The hydraulic regime is highly sensitive to the rainfall pattern and the specific nature of the river's outlet (Bagchi, 1944, 1977; Bhattacharyya, 1998). During the monsoons, the run-off from the hills of upper catchment area descends quickly from the uplands carrying huge amounts of silt. On reaching the flat land, the silty waters find the river already inflated. The Hooghly river, into which the Damodar flows, is also inflated at this time, preventing outflow (Saha, 1938). The extremely low

² My doctoral research was on the lower Damodar valley but it explored primarily the urbanisation process in the region based mainly on census data (see Lahiri-Dutt, 1985). Since the latter part of the 1990s I became closely associated with some locally based civil society groups and individuals who encouraged further and ongoing interest on the impacts of floods and *boro bandhs*.

gradient also ensures that waters drain very slowly. Above all, the Hooghly, being a tidal river, only allows intermittent release of water into the Bay of Bengal each day.³

The monsoon run-off used to descend down the river channel with great force, giving rise to flash floods known locally as *harka ban* (Hunter, 1876).⁴ Dramatic shifts in the river's course accompanied these monsoonal floods. The annual inundations washed away the drainage congestion and gave rise to an unusual concentration of agrarian population and settlements in this deltaic stretch of Bengal (Mukherjee, 1938). Yet, the river came to be known as the 'river of sorrow', or the 'sorrow of Bengal' during the colonial times, and civilising the river by 'river training', 'river control', 'taming', and 'harnessing' its aberrant and uncivil behaviour became a project of the colonial state (Lahiri-Dutt, 2000). Frequent 'inundations' and 'subnormal' floods occurring with a certain amount of regularity were accommodated, like people still do in Bangladesh. The mainstream wisdom, unfortunately, often failed to recognise the importance of local knowledge that was based on adjustment measures (Bhattacharjee, 1986).

In the past, village communities in the lower Damodar valley had adjusted in various ways to the excesses of water. Willcocks (1930) described this flood-dependence as 'overflow irrigation' in which the fine clay and humus-rich crest water reaches the fields through cuts on the banks of the canals – called *kanwas* – and spill channels or *hanas*. The inundation fertilised the soil, checked the spread of malaria, and helped to turn the lower Damodar valley into a productive area. Indigenous crop varieties grew ahead of the rising flood waters, and the cropping calendar was suited to the phases of inundation (Brammer, 1990; Hofer and Messerli, 1997). Even the standing water of the swamplands was used to ret jute crops (Chapman, 1995). An intricate network of ponds, aqueducts, and water tanks provided seasonal storage of water as well as drainage. Houses in flood-prone areas were built on raised plinths to withstand the onslaught of the worst flooding.

Early measures to control the Damodar included embankment construction to contain the monsoonal flows within the channel (the *bandhs* or *pulbandis*, also known as dikes or levees) (O'Malley and Chakravarti, 1909).⁵ Experts on the Damodar valley agree that the embankments "did more harm than good" (Banerji, 1972). Some villages became physically isolated from the rest of the region. Such isolation must have had important social effects on the well-being of villagers such as access to education and health, information, and communication.

Over many years of their existence, these embankments have now become a part of the local cultural landscape. Women and men from local villages use these spaces for social interactions, transport routes, and for shelter on higher ground especially during floods.

Total control of the Damodar river was envisaged in 1943, after the river breached its left bank embankment. Following the proposal of the Damodar Flood Enquiry Committee, to establish a 'multi-purpose' river valley project modeled after the Tennessee Valley Authority, the DVC was set up in 1948, which involved the construction of dams at Tilaiya, Maithon, Panchet, and Konar with hydroelectric stations connected to each dam. Thermal power stations and the Durgapur barrage⁶ and canals leading off from it were also built. It was envisaged that the second phase would cover the construction of four

³ The tidal fluctuation at the mouth is as much as 4 metres.

⁴ Meghnad Saha, the famous Bengali scientist and one of the key architects of the river control plans noted this 'maldistribution' as the 'source of trouble': "the rainfall coming in abrupt surges and lasting only for a short period in the year during the monsoon months" (Saha and Ray, 1942).

⁵ As early as 1925, Dr C.A. Bentley advocated the reintroduction of flood waters into the Bhagirathi-Damodar *doab* as well as in the trans-Damodar tract in his book *Malaria and Agriculture in Bengal*. In 1931, Mr C. Adams Williams stated that the silt-laden waters be used to increase the fertility of the soil and decreasing the ravages of malaria.

⁶ As the number of dams was reduced, to have better control over the run-off, the Durgapur barrage was constructed in place of the weir suggested by Voorduin.

more dams and hydroelectric stations;⁷ however, only the first phase was completed by this 'dream-child of Nehru'.⁸

The impact of the DVC on the regional economy has been studied intensively (see, for example, Chatterjee, 1967), and scholars have been critical of this largely unsuccessful project. The reasons, besides its lack of completion, include poor governance and technical defects as well as the fact that the DVC has deviated significantly from its aims of flood control to meet the national priorities and regional needs for the generation and distribution of electricity (Aich, 1998). The operations of the Durgapur barrage, the canal networks, and dams are not integrated. Interstate disputes between Bihar and West Bengal over irrigation allocation and failure to acquire land led to the inability of the dams to fully control the flood. Allegations of corruption in the internal matters of the DVC have also been raised. Since the late 1960s, the region also has come under intensive agricultural development programmes, with the irrigation-seed-fertiliser technology package, resulting in the introduction of groundwater usage, a late winter/summer crop called *boro* rice, and extensive urban growth at the western and eastern edges of the valley. These changes make it difficult to attribute agrarian changes solely to the DVC.

The changes, understandably, have been of great significance to the regional rural economy. I focus selectively on four aspects of these changes – floods caused by the DVC, the use of groundwater for irrigation utilisation leading to changes in cropping pattern, *boro bandhs*, and exploring the resultant gender-differentiated impacts.

Gender impacts of floods since DVC

Recent floods

There have been three major floods since the DVC dams came into existence: in 1958, 1978, and 1998. The scrutiny was intense especially after the devastating 1978 flood, "the biggest ever handled by the DVC" according to one of its reports (DVC, 1980). The 1978 flood occurred because of a combination of excessive rains from cyclonic cloud-burst of the retreating monsoons in late September and the release of a large amount of water from the over-filled reservoirs.⁹ Similarly, in 1998, another major flood kept the lower valley under water for nearly a week. However, rainfall and run-off in the catchment below the dams was a significant contributor to these floods. Again, in 2006, the DVC released excess water from its dams through the canal system during the peak monsoon to save the dams. This water heavily inundated villages at the tail end of the canals.

A consistent pattern that downstream villagers have complained about is the release by DVC of excess water into the canals during late monsoons to protect the dams without adequate warning. The artificial inundation caused in the lowest end of the river valley, and the associated misery, is seen by the villagers as largely avoidable. Besides these three major floods, on numerous occasions the DVC dams have released water exacerbating the usual monsoonal inundations. Given the objective of the DVC to control the floods, its role in increasing the floods reveals an embedded contradiction.

Short- and long-term impacts on livelihoods

Whether occurring naturally or caused by humans, floods have major and direct impacts on rural livelihoods. One immediate, physical impact with long-term consequences for the well-being of the

⁷ The government of Bihar later constructed the fifth dam at Tenughat in place of the Aiyar, funding for which was given as a loan to the state, and which is not integrated to the DVC system. It supplies water mainly to the Bokaro Steel Plant and the thermal power station.

⁸ About 93,000 people were displaced from 27,500 ha of land and 45,000 houses. The policy was to give land for land, only if the displaced persons indicated their choices by a certain date.

⁹ The quantity of sand being deposited in the DVC reservoirs has been far greater than that originally envisaged, reducing the lifespan of the dams. This is due to the accelerated pace of mining-based industrialisation and urbanisation in the upper valley.

families is sand deposition on the agricultural land. Flood waters these days carry huge quantities of sand, which are dumped on fertile farming land, destroying the soil quality which takes years to ameliorate. Shifts in the river course and bank erosion are the most dreaded effects of flood; in one disastrous flood, families can lose everything. River bank erosion usually increases at times of flood, affecting especially the poorer families. At times of major inundations, victims are usually chosen by class; the poorer households living further away from the embankments, where the flood waters stay longer, remain marooned for days, whereas the better-off families closer to the higher ground along the embankments are often able to protect themselves. Flooding also causes population displacement; often, such displacements are gendered rather than class-differentiated (as in the case of Bangladesh; see Gray and Mueller, 2010 to find that the effects of crop failure and flooding are stronger for women because they have less secure access to land). Mueller and Quisumbing (2010) have also shown that for remote villages located away from labour markets, floods have significant short- and long-term impacts on wages.

Overall, the longer-term physical impacts include the rising of the river bed, the formation and stabilisation of *chars* or river islands, and the erratic shifting of the river course due to bank erosion. The availability of sand has spurred on local *panchayats* (village councils) to grant licences to extract sand from the river bed, endangering the embankments in many places. One of the longer-term effects is indebtedness as the poor tend to borrow cash from local *mahajans* (money-lenders) to restore their livelihoods.

Gender and floods

Gender differences in the impacts of flood are most notable in the post-flood stage, when the recovery and revival of economic activities takes place. It is at this stage that women's domestic burdens and hardships mount. In the aftermath of a flood, gender-assigned tasks such as procuring, preparing and cooking food take considerably longer and involve a greater physical burden. The need for a more permanent livelihood when the fields are flooded force men from the poorer families to seek waged jobs outside of the area. Consequently, it is common to see a near-mass exodus of younger men from flood-affected villages, leaving women, the elderly, and children in temporary shelters to fend for themselves.

In comparatively better-off farming families the loss of household essentials causes great hardship to women. Men and women bring different kinds of assets into a household; their assets being different in quantity, quality and type. Women's assets are considered less valuable or non-productive, and drawn upon to reconstitute livelihoods after major shocks such as floods. In Bangladesh, Quisumbing et al. (2011) have shown that gender-based differences in responsibilities for coping with shocks have a number of implications for short-term asset accumulation. Women's responsibilities lie in coping with quick and unexpected shocks such as the floods, and indeed, in Damodar valley, families tend to manage short-term financial crises after floods by selling women's assets such as jewellery and livestock. Women are forced to fetch water from distant areas as most of the tube wells are contaminated due to the flood. Reconstruction of the family house is another post-flood job in which women have to add labour. Floods also undermine some of the women's well-being because of their dependence on economic activities linked to the home. Losses of harvest and livestock have a high impact on women, as nearly 58% of them rely on cattle and chickens for their cash income.

Imprisoned by embankments

An ad-hoc response to rising river beds and persistent floods by the government has been the gradual raising of the embankments. The embankments have had serious gendered consequences. While they are used as community spaces, especially by women as spaces for social gatherings, crop drying, and for animal rearing, the dykes have also caused isolation by separating neighbouring villages. The high walls of embankments have created complex networks, in places completely surrounding villages. For

example, Dadpur village, about 20 km east of Burdwan town at the apex of the Damodar delta where the river turns nearly 90 degrees to swing to the south-southeast, is encircled by at least three embankments varying in height from 6 to 12 feet. The villagers feel threatened by inundation from breaches in the levees.

Psychological trauma is experienced by all villagers, but for women the resultant frustration is harder. Socially, the embankments mean isolation for women, disruption of their contact networks, and restriction on their physical movements. Many women cite this physical isolation as the main cause for social exclusion, as expressed by Rasmoni Ghosh, a long-term resident of Dadpur: "[w]e have become 'walled in' (*panchile ghera*) by the *bandhs* – it is true that over these we have not much control. As a result, women like us have lost the ability to direct our lives".

For women and men living in the lower Damodar valley, indeed, the floods have not been fully controlled; the nature of floods has changed, while building up a false sense of security amongst the residents of the lower valley (Lahiri-Dutt, 2003). To the disempowered villagers living in the lower reaches of the valley, however, the DVC is the '*dobano bhasano cal*' (the mechanism for inundation and submergence), a grand design that has failed to keep its grand promises to stop flooding and usher in a secure agrarian life.

In a study undertaken jointly with a local non-governmental organisation called the Dakshin Damodar Khara Bonya Pratirodh Samiti, it became clear that a large number of women believed that while the floods have indeed decreased in frequency and magnitude, they have become more unpredictable. An unexpected flood can cause more havoc compared to an expected one, especially if the flood is caused by the very institution that was created to protect the people. Often, the warning that the DVC Control Room is supposed to provide before releasing the water from the barrage fails to reach people in the lower valley in time.

Besides unpredictability, floods have also changed in duration since the construction of the DVC. The inundations stay longer on the ground as the high walls of the embankments prevent flood water from draining away via the channels. About this, a river expert (Aich, 1998) notes: "[b]efore the construction of the DVC dams, the flood peaks were high but the duration was small. The construction of dams has moderated the peaks but increased the duration of floods. This increase in duration has enhanced the chances of synchronization of floods from the upper and lower valleys as also from the adjoining river basins". This scholarly observation resonates in the voice of an elderly inhabitant of the Siyali village: "[p]reviously, we had floods, but we knew how to deal with them. We did not die from floods. Now we do not have regular floods, but when they come, they take us by surprise".

Many women are mortally scared of the surprise of a sudden onslaught of flood. One of them, Ranubala, observes that she would prefer that the flood warning system is effective so that she could choose more secure higher ground to move to before the waters rose. For her, an early warning means getting more time to consider alternative means of providing security to the children, the elderly, and the smaller domestic animals and is of the greatest importance; for men, the task is to save seed crops, large animals like cattle, and make contact with government officials for relief.

With the changing nature of floods, the perception of them has also altered. This is evident from the fact that simple adjustment measures such as higher plinth levels in rural houses no longer exist; a sense of false security and complacency have taken over. Another woman, Malati Santra, reported to us during the field survey:

[o]ur fear of the river has vanished, but at the same time, we have lost respect for the river. Previously, we used to look up to the river as our deity, part of our lives, but now we treat it as only a sewage channel for the industries. When the river cannot tolerate this anymore, it inundates its banks to remind us of its existence.

The perception of floods is not uniform amongst women and men, and is also circumscribed by status and class position in the rural milieu. When we attempted to create 'social vulnerability maps' containing basic facts about the magnitude of losses experienced by women and men, women's

concerns became apparent from these mapping exercises. Women were eloquent about the need to prevent: politically motivated relief distribution; provide safe drinking water in adequate quantities; combat the spread of water-borne diseases; provide fuel for cooking; and provide safe and secure shelter and private sanitation facilities immediately after the flood. In sharp contrast to these, men were more concerned with protecting the crops.

Gender roles in water-based economies

Gender roles in the lower Damodar valley have closely followed how rural people used and managed water. Water control is of utmost importance in such a community, symbolising Wittfogelian social power. Women in the region have always made significant contributions in managing the household and securing livelihoods. They have also, for a long time, played an active role in agriculture. They performed a wide variety of tasks related to farming: preparing the land; irrigating it; weeding; harvesting; and processing. The older methods of water control hardly impacted on these roles as they did not essentially change the nature of either farming or the crops. Gender role differentiation within farming communities created a clear-cut sexual division of labour whether at home or in the farm.

A survey by a local non-governmental organisation, Agragati (2002), found that women who work on farms outside of home comprised around 28% of the total rural women in this area. However, in the poorer families – *khetmajur* (agricultural labourers), *bhagchasi* (sharecroppers), and scheduled caste and tribes – this proportion rises to over 95%. The main objective of these women is to generate additional incomes for their households; often they also take up roles of petty traders selling fish, fruits, or vegetables besides working as agricultural labourers. Their time-use pattern brought out significant gender differences: extensive hours of exhaustive manual work in the field as well as domestic chores for as many as 14 hours in some cases for women, but only 5 hours for men.

However, with modern methods of water control becoming popular, decision-making in agriculture has tended to become more formalised and centralised among men. This means that women in general, whether from middle-class or poorer families, have lower voice in decisions relating to agricultural activities. With modern machines and fertilisers, men make choices of what to buy, how to buy, and from where to buy or rent these machines. Less decision-making power does not mean that the numbers of women participating in agriculture have decreased; on the contrary, more women at present work as landless labourers in the three districts than elsewhere in the state of West Bengal. Many of the women agricultural labourers belong to scheduled castes and tribes, and have temporarily migrated from the neighbouring poorer districts as part of family and kin groups to work as itinerant labourers. However, with the introduction of modern methods of water control, farming practices have also changed in favour of machines. Whilst they have decreased the manual nature of jobs in the fields, the mechanised jobs, such as driving tractors, have been taken up by men. This has led to a situation where those jobs performed by women have consistently remained either manual, or women have been pushed into unmechanised job areas where under-investment in technology is the hallmark. For women living in flood-prone villages, life in general has become more burdened with heavy manual jobs while at the same time they have become marginal in farming. At the same time, social stigma attached to female work participation still persists or has increased and is considered a sign of the poverty of a family.

Agriculture, irrigation, and gender since the DVC

Let us now turn to the DVC's impacts on local agriculture and economy. Lower Damodar valley has always been a rich farming tract, its swamplands are cultivated with jute and in early winter, farmers harvest a crop of indigenous rice. Since the advent of the DVC, the cropping pattern has changed; there has been a decline in the jute industry and boro (summer) rice, and HYV seeds rice have become popular. This rice cultivation is entirely dependent on irrigation and has opened up new modes of water control in the region. Boro rice is a water-intensive crop, and farming families suffering from the

deluges caused by the DVC during monsoons are justified in demanding canal water. The unified development plan for the Damodar valley had the supply of irrigation water as one of its objectives, but it was not clear exactly when this water would be delivered.¹⁰ Currently, about 1.7 million acre feet (>2 billion cubic metres) of water are earmarked for annual irrigation. The DVC claims that the two canal systems were supposed to provide irrigation water to the command area only during the kharif (main/monsoon cropping) season to supplement seasonal fluctuations in natural rains. The DVC position is evident from Banerjee's (1991) view that water for boro rice, if supplied at all, is a gesture of benevolence. The objective of supplying irrigation water to the kharif crop was not very successful; quite early, Basu and Mukherjee (1963) made an evaluation of the economic benefits of irrigation in the Damodar region. This study noted that the older canals such as the Eden Canal and the Damodar Canal – merged later in the DVC irrigation network – are actually more efficient in bringing economic benefits to the farmers of the region. Many later studies have confirmed that large-scale canal irrigation – officially held as the most effective means of irrigating the farms – is actually far less cost-effective.¹¹

This is indeed an irony – *boro* irrigation is not provided in the original scheme and hence there is no allocation of water for it – but the areas that need this additional water most are located in the lowest part of the valley which also suffer during the monsoons from excess water being carried in by these canals.

Groundwater use

Although not directly connected to DVC, a major contributor to the regional agrarian change has been groundwater use. The deep tube wells that have taken over the agricultural fields were in fact an indirect response to the DVC and the incomplete, but capital- and technology-aided agrarian improvement. The need to irrigate crops has multiplied many times, mainly because of the inability of the DVC to provide water when needed. The indiscriminate drawing of groundwater has led to the lowering of the water table; water-intensification of farming; and neglect of surface water sources being most important amongst them.

Each deep or shallow tube well – usually owned by the bigger farmers – draws upon the groundwater commons, and interferes with the drinking water tube wells. These are usually shallow hand pumps, and are more commonly used by women to collect water for household uses. Bela Das, a mother of three, an agricultural labourer with no farmland, complained that her hand pump dries up by mid-February. This forces her to steal water at night from the shallow pumps that are primarily meant for irrigating the fields.

Politics of *boro bandhs*

To cope with the winter water demand by farmers, *gram panchayats* and the block offices of Khanakul 1 and 2 located at the lowest end of the DVC irrigation command area locally construct *boro bandhs* – seasonal sand barriers across the river bed – to irrigate the rice fields of richer farmers. Every year, the district government of Hooghly spends over US\$400,000 – not an insignificant amount of money for a small district administration – to construct a series of six or eight *aar bandhs* (cross-dams) on the river in January to impound water for the winter (or boro) rice crop. Supported by logs, these *bandhs* can be

¹⁰ Commenting on Voorduin's Preliminary Memorandum, Mr H.M. Mathews, Chairman of the Central Technical Power Board, noted in 1947: "under the proposed plan of development it would be possible to undertake the perennial irrigation of about 760,000 acres including the... area covered by the Damodar-Hooghly Flushing and Irrigation Scheme which was approved by the Bengal Legislative Assembly in 1939". To realise this objective, in the early days, in 1956, DVC set up an Experiment-cum-Demonstration Station at Panagarh just downstream of the Durgapur barrage. This station was meant to exhibit the beneficial effects of 'modern' irrigation farming for 'optimum production on a sustained basis' (United Nations Economic Commission for Asia and the Far East, 1960).

¹¹ For example, Dhawan's 1997 research using National Accounts Statistics data from 1980-81 to 1992-93, shows that canal irrigation might actually not be considered as an economically viable proposition.

up to 12 metres high and 8 metres wide, and are built across the river; they are washed away by the first flush of the monsoons. Each of these *aar bandhs* can cost between Rs15 to 25 lakhs depending on their size. These *boro bandhs* also increase the environmental risks as they are flimsy and can be flushed away by a strong current and entirely submerge the crops downstream.

For the farmer families of Khanakul, whose summer crop is destroyed by inundations often caused by poor drainage in the DVC system, this boro crop is vital in earning the year's cash, and the demand for water is a legitimate one that is not fulfilled. If, following Mollinga (2001), we interpret the *boro bandhs* as representing the informal embodiment and the realisation of local water rights within the DVC command area, the *bandhs* have certainly not been inclusive of both rich and poor, women and men, in how decisions about their precise location are made or who gets the benefit and who suffers from them.

For women, the *boro bandhs* are symbolic of the modern water management system that the DVC has brought into existence. As such, in the lower Damodar valley women's legal rights over farming land do not usually get translated into real control or power, but when a politically motivated system of irrigation assumes predominance, women are the first to be left behind. The invisibility of women as farmers is apparent from a participatory appraisal we undertook with the help of Helan Pally Prerana Samiti in 2006. In the village Tantishal in Khanakul 1 block, 214 farm-holdings were owned by men whereas only 56 were held in the names of women. However, in the list of those benefiting from *boro bandhs*, there was no land owned by a woman. This is not a coincidence; Bela Das' story elaborates how women are systematically excluded. Bela, a widow with four children inherited the 3 *bighas* of land after her husband's death. She farmed the land herself with the help of her eldest son. However, the *boro bandh* raised by the *panchayat* near her land regularly floods it in winter, while benefiting other farmers. For cash-strapped farm families, the winter crop is crucial in staying or rising above the subsistence level.

As noted by Jha (2004), the freedom to make decisions is central to the idea of participation. If *boro bandhs* strip women of informal decision-making powers that they previously enjoyed, then they are best described as representing oppressive systems of water management. However, these *bandhs* are neither constituted in interaction with irrigation department officials, nor acknowledged by the DVC, and exist in a legal vacuum. There are examples of endogenous water resource management systems (such as those existing in the *haor* basins of Sylhet in Bangladesh described by Duyne-Barenstein in 2008). They too inhabit extra-legal spaces, but in replicating statist modes of water governance, the *boro bandhs* do not represent socially rooted collective action. Moreover, they neglect to recognise that the needs of and interests on irrigation water are gender-differentiated, and exclude women from decision-making. Given the political economy of rural West Bengal, they represent embodied instruments for local political control over water management. Sarkar (2006) noted that for the rural economy of West Bengal, the introduction of labour-intensive boro rice cultivation – suited to the fragmented land of the state – was the most crucial factor in increasing the food production. Thus, watering the *boro* crop has proved to be extremely effective as a political measure. The DVC is partly responsible; because it is frozen in time and unable to meet the contemporary needs of local peasant communities, leaving local political groups to take advantage of the situation and rise to meet the growing water needs.

COPING WITH THE DVC

Both the large-scale dams of the DVC and the micro-scale *boro bandhs* are gendered entities. This is because in recognising only men as participants in the water management institutions that they represent, they create and reinforce certain gender norms in farming families. They exclude women from getting the benefits from them. Gender composition of various committees that decide on water management at various scales reveals that women are almost always absent. Above all, the DVC, although it has decreased the predictability of floods it has also increased their destructive power,

burdening women with the responsibility of finding a means to survive, to procure food for children, and ensuring physical safety for themselves and their families. In 2002, the World Commission on Dams observed that "the poor... vulnerable groups and future generations... bear a disproportionate share of the social and environmental costs of large dam projects without getting a commensurate share of the... benefits". In the lower Damodar valley, as we can see, women carried the burden of negative impacts of centralised water management, whereas some men reaped the benefits.

In summary, the river control measures have created a complex web of practical difficulties for rural inhabitants, endangering the survival of the poorest groups of people, and burdening women with the responsibility of coping with these difficulties. The changes have been social and economic in terms of altering the farming economy, but also perceptual and aspirational in the sense which has fostered the view that floods are undesirable and water supply is unlimited. The system, in putting a new water control mechanism, has created aspirations and expectations of a steady supply of water to the agricultural fields that have not been fulfilled. The changes have been accompanied by the introduction of technology that enabled the withdrawal of large quantities of groundwater at will. Above all, the DVC has changed the hydrological regime of the river leading to unforeseen impacts such as erosion of the river bank, and shifting river courses. The floods that occur now are often caused by the release of water from upstream dams into already inflated rivers with poor drainage, and they disrupt lives and livelihoods of families.

The water control measures place women at the lowest level of the emerging farming economy with regard to their decision-making power and voice, and their visibility as productive agents participating as equals in the new economy. Moreover, while affecting everyone in the region, the changes have negatively impacted on women's lives in particular. The physical burden of coping with floods falls heavily on women as they bear the responsibility of sustaining life in the short term and of restoring the incomes of their families in the longer term.

In spite of their social constraints, women in the lower Damodar valley have not remained mere victims of the floods created by the DVC. There are instances of women taking up leadership or showing astounding courage and strength in the face of adversity. The level of improvisation by women in dealing with the extreme lack of resources, privacy, and support is extraordinary. Many women in such distressing situations have, individually and in groups, proven that they have more to them than what is given by their social milieu. This intangible quality is best described as resilience and spirit, and is difficult to incorporate in broader terminologies such as 'adaptation'.

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